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Forest Insect and Disease Management

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BIOLOGICAL
EVALUATION R2-76-14

SHOESTRING ROOT ROT OF
PINYON-JUNIPER STANDS

San Isabel National Forest

BLM, State and
Private Lands

December 1976

Rocky Mountain Region

U.S. Department of Agriculture Forest Service

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INTRODUCTION

During aerial and ground surveys conducted in 1975 and 1976 over most of the pinyon-juniper type in Colorado (see map-Figure 1), large areas of dying and dead pinyon (*Pinus edulis* Engelm.) were detected and mapped. Disease centers west of the Continental Divide were diagnosed as caused by black stain root disease, *Verticicladiella wagenerii* Kend., and subsequently reported by Landis and Helburg (1976). Similar appearing disease centers east of the Divide, upon ground checking, were found to be caused by shoestring root rot, *Armillariella mellea* (Vahl. ex Fr.) Karst. (Figure 2). This report contains observations and data collected during ground surveys for *A. mellea*.

EXTENSIVE SURVEYS AND IDENTIFICATION OF CAUSAL AGENT

During 1976, four areas distributed throughout the pinyon-juniper type east of the Continental Divide were ground checked to diagnose the cause of large areas of dying and dead pinyon (Figures 1 and 2). The following areas were examined in detail:

Buena Vista (Trout Creek) - 3 miles SE, T. 14 S., R. 78 W., Sec. 23 & 24 (BLM and Private lands - 1 mile to San Isabel National Forest)

Poncha Springs (Maysville) - 3 miles W, T. 50 N., R. 7 E., Sec. 34 & 35 (BLM and Private lands - 1 mile to San Isabel National Forest)

Cotopaxi - 3-6 miles N, T. 49 N., R. 12 E., Sec. 28 and 33 (BLM and Private lands) T. 48 N., R. 12 E., Sec. 7 and 18

Gardner - 8 miles W, T. 41 N., R. 71 W., Sec. 10 and 15 (BLM and Private lands - 5 miles to San Isabel National Forest)

Dying and dead pinyon exhibited symptoms and signs characteristic of *A. mellea* infection (Figure 3). Examination of root collars and excavated roots of symptomatic trees disclosed white mycelial fans and resinosis on both pinyon and Rocky Mountain juniper (*Juniperus scopulorum* Sarg.) (Figure 4). This pathogen has been previously reported on pinyon but not Rocky Mountain juniper in the United States. This new host record subsequently was reported by Johnson, Landis and Gillman (1976).

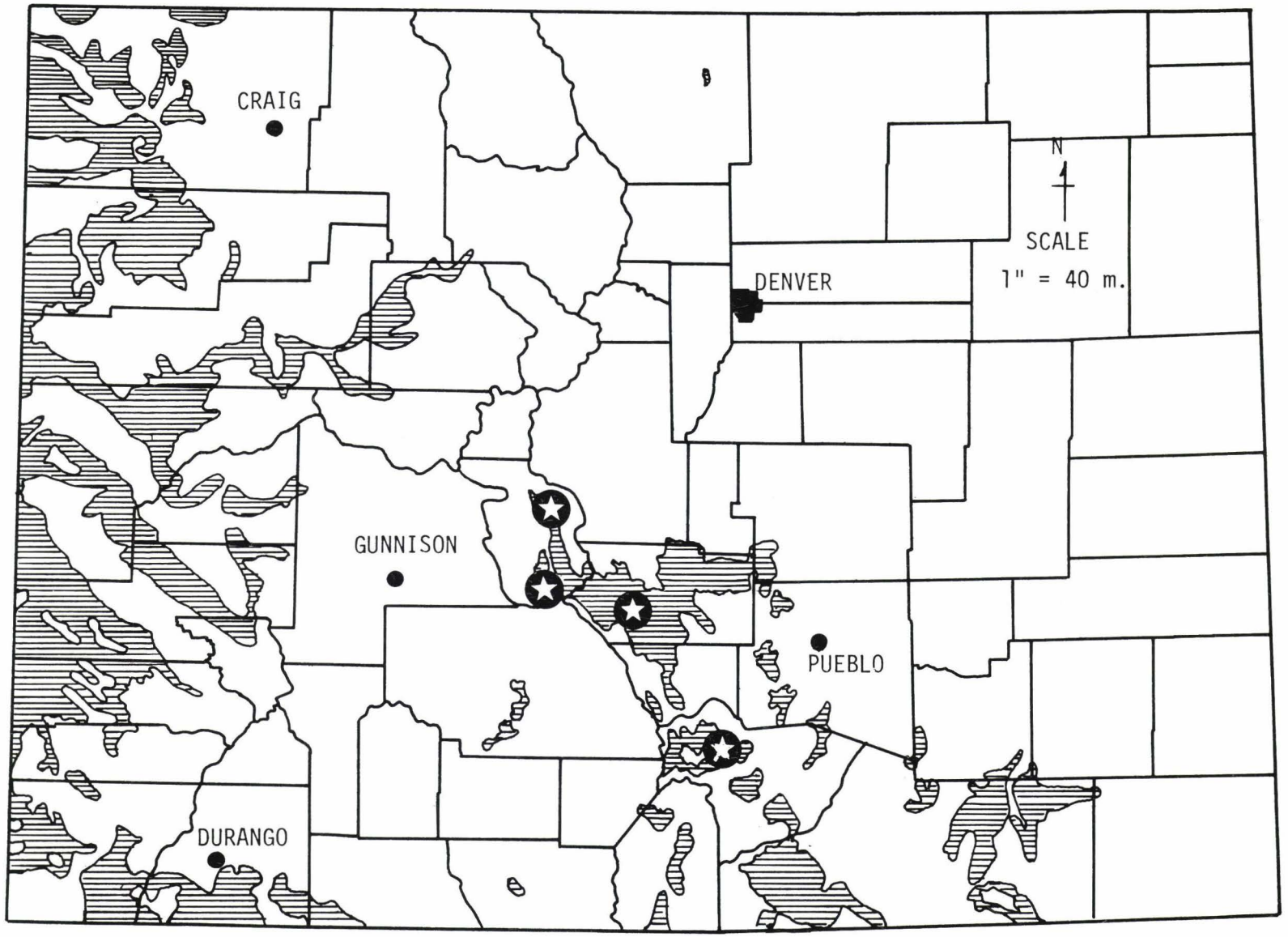

Figure 1 - *Armillariella mellea* was found in four general locations in eastern slope pinyon-juniper stands.

Figure 2 (Facing Page) *Armillariella mellea* root rot of pinyon-juniper forest

(a) Aerial view of a typical disease center in pinyon-juniper type. Lighter colored trees near the center of the photo are dead pinyon. This area located near Buena Vista, Colorado.

(b) Dead and dying pinyon in a disease center near Cotopaxi, Colorado. Infected pinyon at left side of the photo with typical symptom-thin crown. The ponderosa pine in the center of the photo was unaffected by the disease.

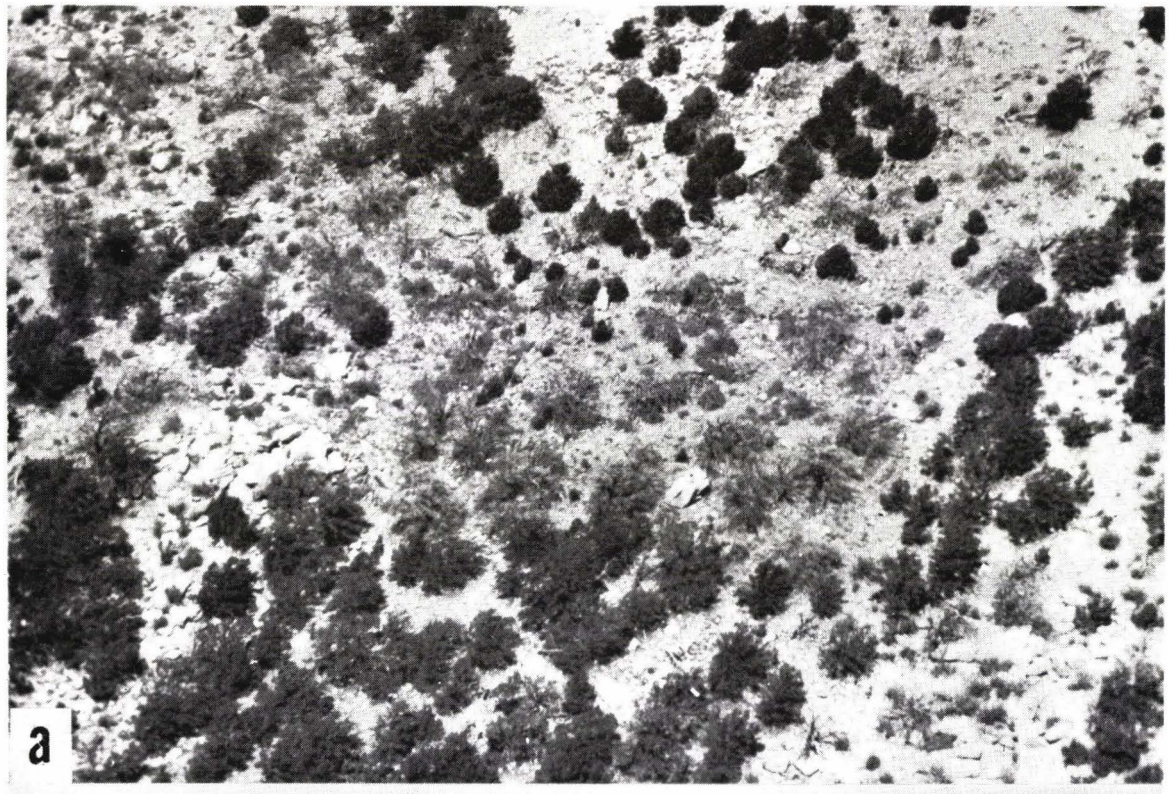
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Figure 3 (Facing Page) *Armillariella mellea* root rot of pinyon.

(a) Infected pinyon with typical crown symptoms.

(b) Base of infected pinyon showing mycelial fans characteristic of the fungus.

(c) Close-up of mycelial fans.

(d) Resinosus (whitish areas) evident at base of tree and on infected roots.

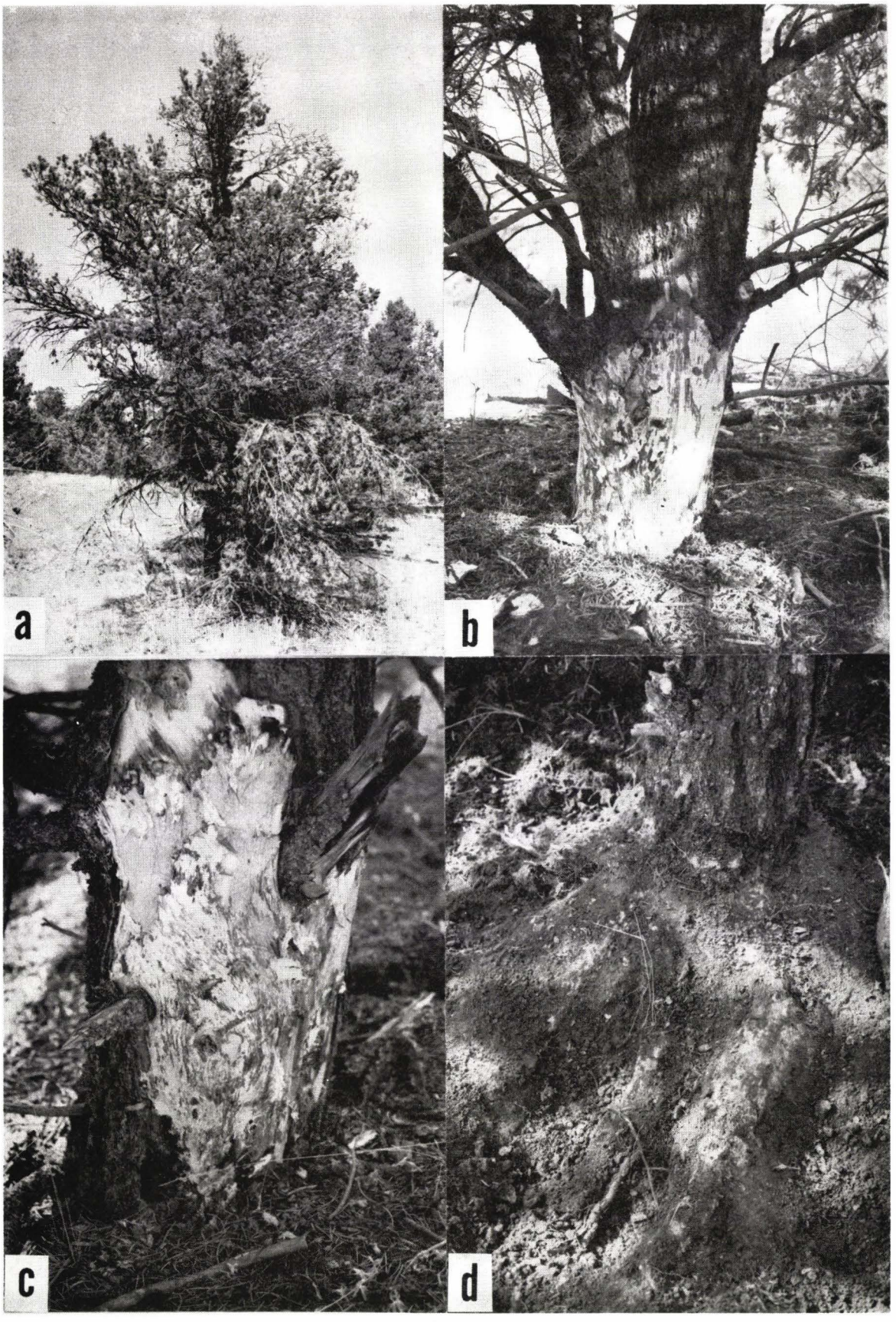
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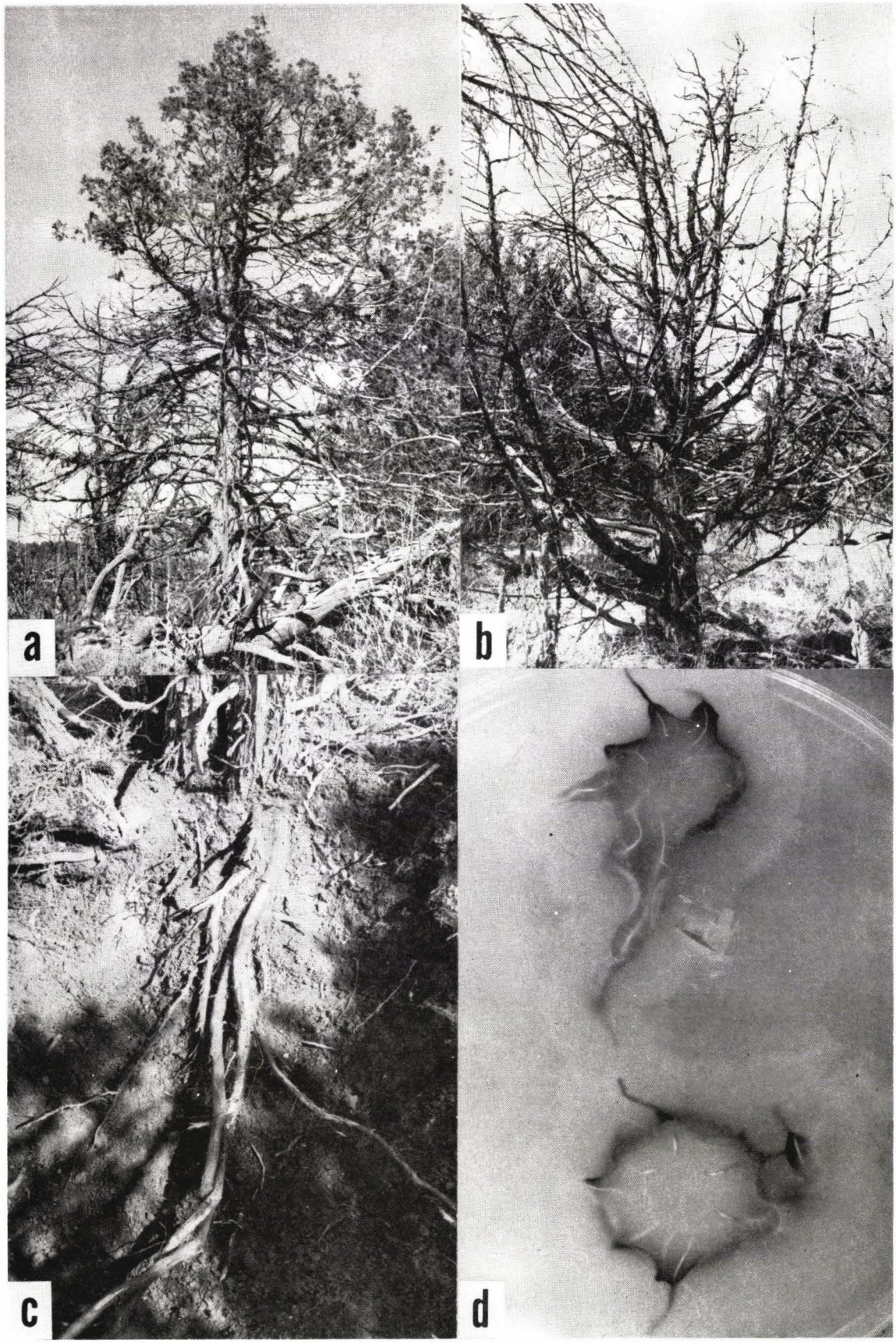
Figure 4 (Facing Page) *Armillariella mellea* root rot of Rocky Mountain juniper

(a) Infected juniper with typical crown symptoms.

(b) Juniper killed by *A. mellea*.

(c) Excavation of root systems revealed the fungus moved tree-to-tree via root contacts.

(d) *A. mellea* isolate from juniper. Rhizomorphs (black root-like structures) formed in 7-10 day-old cultures of the fungus on agar media. View of bottom of a culture dish.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Stem and root samples bearing mycelial fans were collected from suspect trees and cultured in the laboratory. Tissue from the periphery of the mycelial fans was surface sterilized with 0.5 percent sodium hypochlorite (chlorox) and rinsed 30 seconds in sterile distilled water before culturing on Difco potato-dextrose agar amended with 15 ppm methyl 1 - (butlycarbamoyl) - 2 - benzimidazole carbamate (benomyl 50% WP). Plates were incubated in the dark at 24° C.

Tissue isolations yielded pure cultures of *A. mellea* in 7-10 days as confirmed by the production of rhizomorphs (Figure 4). These fungal cultures supported the field diagnosis that *A. mellea* was a primary factor causing the disease centers in east slope pinyon-juniper stands.

INTENSIVE SURVEYS

During December 16 and 17, 1976, two areas north of Cotopaxi, Colorado were chosen for an intensive survey because of the abundance of disease centers, as noted during aerial surveys.

All trees over three feet tall were recorded within a strip one-half chain wide and 80 chains long (encompassing a total of 4 acres in each area). The presence of *A. mellea* was investigated on all dying and dead trees within the strip. The results of the surveys are presented in Table 1.

The first area located west of Long Gulch (T. 49 N., R. 12 E., Sec. 28 and 33) had an average of 228 trees per acre. Pinyon comprised 82.4 percent of the tree species composition. *Armillariella mellea* was noted on 41 trees per acre. This represented 18.1 percent of the trees sampled. A total of 12 discrete disease pockets were observed along the strip.

The second area located east of Bernard Creek (T. 48 N., R. 12 E., Sec. 7 and 18) had an average of 228 trees per acre. Pinyon comprised 76.7 percent of the trees. *A. mellea* was identified on 20 trees per acre, representing 8.8 percent of the trees sampled. A total of 17 disease centers were noted along the strip.

In both areas surveyed there were relatively few new infections (Table 1). Many pockets were quite old as evidenced by old blow-down and decayed roots. The initiation and intensification of shoestring root rot in these pinyon-juniper stands may have been related to some disturbance in the past history of the stand. There was evidence of fire in the Long Gulch area which may have stimulated disease development. No such relationship could be found in the Bernard Creek stands so the reason for the intensification of *A. mellea* remains unclear.

TABLE 1

Armillariella mellea survey - Cotopaxi, Colorado

Tree Species	Tree Condition	SURVEY AREA: Long Gulch (Total No. of Trees)	SURVEY AREA: Bernard Gulch (Total No. of Trees)
Pinyon	Live	552	591
	A. m. dead [1/]	151	69
	A. m. infected [1/]	10	10
	Unknown dead	39	29
Juniper	Live	111	210
	A. m. dead	0	0
	A. m. infected	4	1
Ponderosa pine	Live	24	1
	A. m. dead	0	0
	A. m. infected	0	0
Douglas-fir	Live	22	1
	A. m. dead	0	0
	A. m. infected	0	0

1/ *A. m.* dead and infected - *Armillariella mella* attributed as the cause of death or infection.

Differences in the relative susceptibility of the various species to infection by *A. mellea* were very obvious. Ponderosa pine (*P. ponderosa* Laws.), Douglas-fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.)Franco) and Rocky Mountain juniper were present within and adjacent to infection centers; however, no infected or dead ponderosa pine or Douglas-fir were noted (Table 1). Only 4 infected juniper were noted in Area 1 and one in Area 2.

Additional work on the host range of *A. mellea* in the pinyon-juniper forest type is warranted.

DISEASE IMPACTS

The impact of the disease on the pinyon-juniper resource is probably minimal. The rate of spread of individual disease centers is relatively slow and most areas are revegetating to pinyon, juniper, other conifers and oak brush. The disease may be considered beneficial in some areas in creating natural stand openings that lend greater diversity to the type and more suitable wildlife habitat. Large disease centers may create more forage for sheep and cattle.

Adverse effects of the disease include the unsightly appearance of dead and dying trees particularly if adjacent to home or recreation sites. Windthrow of weakened trees create barriers to domestic animal travel and increased fire hazard. A secondary adverse effect of the disease is the creation of brood material for bark beetles that may aid population build-up and subsequent infestation of adjacent healthy stands.

RECOMMENDATIONS

At this time no control effort of the disease is warranted, except in areas adjacent to designated recreation sites or home sites. In these cases, the FIDM Pathologist or Colorado State Forest Service should be consulted to develop suitable control measures.

LITERATURE CITED

1. Landis, T. D. and L. B. Helburg. 1976. Black stain root disease of pinyon pine in Colorado. Plant Disease Reporter 60 (8):713-717.

2. Johnson, D. W., T. D. Landis, L. S. Gillman. 1976. Rocky Mountain juniper, a new host of *Armillariella mellea* in Colorado. Plant Disease Reporter 60 (10):886.